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Ag BL Description for General Atomics

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Disclaimer

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The Material Strength campaign at LLNL is an effort to measure the resistance of materials to deformation when placed under large stresses. These experiments are carried out at large laser facilities, where a laser-driven plasma pusher creates a pressure in excess of 5 Mbar (on the NIF) or 1 Mbar (at OMEGA) in the sample of interest. Strong materials resist deforming in response to these high pressures, and the magnitude of the strength can be inferred using an x-ray probe traversing the sample. The x-ray source used for this probe must be bright, high-energy, and spatially coherent. To achieve all of these things, silver micro-wires and micro-flags are an essential diagnostic tool.

Silver is an ideal material for this work because the characteristic x-ray emission energy from silver (~22 keV) is high enough to penetrate x-ray opaque materials of interest, including tantalum. This is in contrast to lower atomic number elements that are commonly used as x-ray sources, for example titanium or copper, which do not produce x-rays of sufficiently high-energy. Conversely, higher atomic number materials like tungsten and gold do not produce line-emission x-rays as efficiently as silver, and thus produce x-ray sources which are not bright enough for the material strength experiments. Finally, silver x-ray sources can be fabricated accurately in a range of geometries, from tiny wires to thin foils, each of which has been used for measurements of material strength in laser experiments.

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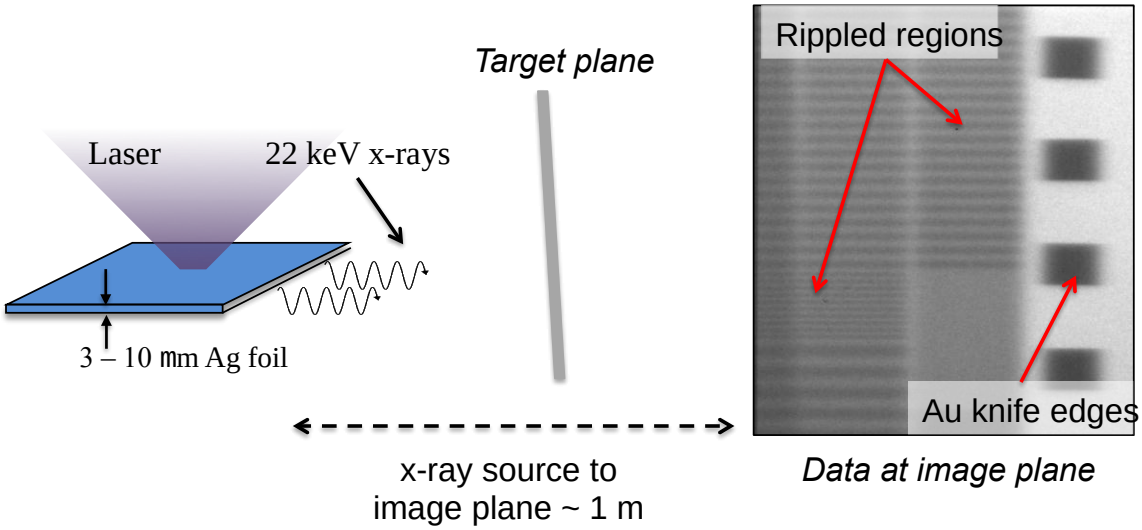

Figure: Geometry for Ag NIF experiments. A 3 or 10 micron-thick Ag foil is laser-irradiated to produce 22 keV x-rays. The x-rays pass though the sample of interest and are recorded on an image plate detector.